

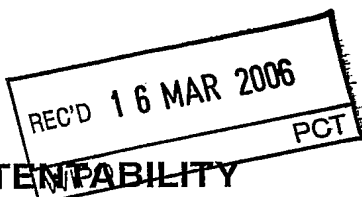
# PATENT COOPERATION TREATY


## PCT

### INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)



Applicant's or agent's file reference 158320-2 DK	<b>FOR FURTHER ACTION</b>		See Form PCT/IPEA/416
International application No. PCT/IL2005/000172	International filing date (day/month/year) 10.02.2005	Priority date (day/month/year) 12.02.2004	
International Patent Classification (IPC) or national classification and IPC C02F1/52, C02F1/66, C02F1/72, C02F9/00, C02F1/48, C02F11/14			
Applicant UNIQLREEN-WASTEWATER TREATMENT LTD. et al.			
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 5 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau) a total of 5 sheets, as follows:</p> <p style="margin-left: 40px;"><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p style="margin-left: 40px;"><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>			
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>			
Date of submission of the demand  08.12.2005		Date of completion of this report  15.03.2006	
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465		Authorized Officer  Borello, E  Telephone No. +49 89 2399-7378	



# INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.  
PCT/IL2005/000172

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## Box No. I Basis of the report

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1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
  - ☐ publication of the international application (under Rule 12.4)
  - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements**\* of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

### Description, Pages

1-29 as originally filed

### Claims, Numbers

1-40 received on 16.12.2005 with letter of 08.12.2005

### Drawings, Sheets

1/2, 2/2 as originally filed

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
  - ☐ any table(s) related to sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
  - ☐ any table(s) related to sequence listing (*specify*):

\* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/IL2005/000172

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**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

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1. Statement

Novelty (N)	Yes: Claims	1-30
	No: Claims	31-40
Inventive step (IS)	Yes: Claims	
	No: Claims	1-40
Industrial applicability (IA)	Yes: Claims	1-40
	No: Claims	

2. Citations and explanations (Rule 70.7):

**see separate sheet**

**Re Item V**

1. Reference is made to the following documents:  
D1: US-A-5 202 030 (AXNAES ET AL) 13 April 1993  
D2: GB-A-2 206 342 (RAYMOND LEONARD SUKOVIEFF) 5 January 1989  
D3: PATENT ABSTRACTS OF JAPAN vol. 2000, no. 02, 29 February 2000 (2000-02-29) -& JP 11 319844 A (HITACHI LTD), 24 November 1999  
D4: WO 03/097539 A (WATER RESEARCH COMMISSION; UNIVERSITY OF CAPE TOWN; LOEWENTHAL, RICHAR) 27 November 2003  
D5: US-A-5 685 993 (LIU ET AL) 11 November 1997
2. Whilst the invention of claim 1 can be considered to be novel over D1-D5, it appears to lack inventive step (Art. 33.3 PCT).

The process of the invention of claim 1 comprises steps a) to f), whereby steps a), b), c) and e) can be in any sequential or simultaneous order.

D1 discloses the treatment of an industrial waste water by adding magnetite powder, limestone and caustic soda to adjust the pH, air as oxidant and various coagulation and flocculation aids. Separators are used to separate the flocks and to dewater the sludge. A magnetic separator is used to recover the excess magnetite (sludge) is separated.

D1 doesn't disclose explicitly the step of decreasing the pH. The objective problem can be formulated as how to improve the process to treat a waste water effluent with a higher pH.

The skilled person knows that the pH is an extremely important parameter to control and affect coagulation and flocculation.

D1 already discloses a two-steps pH adjustment allowing precipitation in two different pH ranges, namely 5.5 to 6.5 and about 7.5 (Cf. D1: col. 1 lines 49-60).

The skilled person would therefore amend the process of D1 and use an acidic coagulant to decrease the pH and work in the appropriate pH range, if he should start from a basic waste water. Therefore it seems obvious that the skilled person would modify the process of D1 including a pH decreasing step of claim 1.

The additional features of dependent claims 2-13 and 15-20, 22-30 are either known from D1-D5 or do not appear, in combination with the features of any claim to which they refer, to involve an inventive step (Art. 33.3 PCT).

Claims 14 and 21 comprise features, which, if taken in combination with the features of claim 1, would make up an invention, which appears to be clearly defined, novel and involving an inventive step in view of the cited prior art.

3. The invention of claim 31 cannot be considered to be novel over D1-D5 (Art. 33.2 PCT).

The plant of claim 31 does not differ from the plants disclosed at least in D3 and D5. The cited prior art discloses plants comprising a static mixer, several coagulator and flocculator tanks, a feeder for ferromagnetic powder, an oxidizer apparatus and a magnetic separator downstream of the mixer.

The additional features of dependent claims 32-40 are either known from D1-D5 or do not appear, in combination with the features of any claim to which they refer, to involve an inventive step (Art. 33.3 PCT).

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**CLAIMS:**

1. A method for treating industrial wastewater, comprising:

(a) introducing powder of a ferromagnetic particulate material into the wastewater in an amount effective to provide magnetic susceptibility to sludge;

5 (b) adjusting a value of a pH of the wastewater by adding basic coagulant, thereby elevating the value of the pH of the wastewater to a first predetermined value of the pH;

(c) adjusting a value of a pH of the wastewater by adding acidic coagulant, thereby decreasing the value of the pH of the wastewater to a second predetermined  
10 value of the pH;

(d) oxidizing the wastewater having an adjusted value of the pH;

(e) flocculating the wastewater by adding at least one flocculant agent selected from cationic flocculant and anionic flocculant, to form flakes of the magnetic sludge in water; and

15 (f) separating the magnetic sludge from the water.

2. The method of claim 1 wherein the wastewater includes at least one component selected from heavy metals, oil products, detergents, phenols, dyes, complexions, and complexionates.

3. The method of claim 1 wherein particle size of said ferromagnetic particulate  
20 material is in the range of about 1 to 100 microns.

4. The method of claim 1 wherein of said ferromagnetic particulate material is made of ferrites of heavy metals.

5. The method of claim 4 wherein the ferrites include at least one element selected from zinc ferrite, magnetite ( $\text{Fe}_3\text{O}_4$ ), gamma-hematite ( $\text{gamma-Fe}_2\text{O}_3$ ), Barium  
25 ferrite ( $\text{BaFe}_2\text{O}_4$ ).

6. The method of claim 1 wherein the amount of said ferromagnetic particulate material introduced into the wastewater is in the range of about 5 to 30 mass % of the entire amount of inorganic coagulants introduced into the wastewater.

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7. The method of claim 1 wherein said first predetermined value of the pH of the wastewater is in the range of about 9 to 14.
8. The method of claim 1 wherein the powder of ferromagnetic particulate material is introduced before the basic coagulant.
- 5 9. The method of claim 1 wherein the powder of ferromagnetic particulate material is introduced after the basic coagulant.
10. The method of claim 1 wherein the powder of ferromagnetic particulate material is introduced simultaneously with the basic coagulant.
11. The method of claim 7 wherein the oxidizing of the wastewater is carried out  
10 by adding a first oxidizer being efficient at high pH.
12. The method of claim 11 wherein the first oxidizer is sodium hypo chlorite.
13. The method of claim 1 wherein said second predetermined value of the pH of the wastewater is in the range of about 6 to 9.
14. The method of claim 1 wherein the acidic coagulant is introduced after the  
15 basic coagulant.
15. The method of claim 1 wherein the acidic coagulant is a salt of iron or aluminum.
16. The method of claim 1 wherein the oxidizing of the wastewater is carried out by adding a second oxidizer being efficient at low pH.
- 20 17. The method of claim 16 wherein the second oxidizer is selected from hydrogen peroxide and ozone.
18. The method of claim 16 wherein the oxidizing of the wastewater with the second oxidizer is carried out after the flocculating of the wastewater.
19. The method of claim 16 wherein the oxidizing of the wastewater with the  
25 second oxidizer is carried out before the flocculating of the wastewater.
20. The method of claim 16 wherein the oxidizing of the wastewater with the second oxidizer is carried out before and after the flocculating of the wastewater.
21. The method of claim 1 wherein the separating of the magnetic sludge from the water is carried out by applying a magnetic field across an effluent of the  
30 wastewater after the flocculating.

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22. The method of claim 21 wherein a linear velocity of an effluent flow is greater than 100 m/hour, the sludge has the floccules lesser than 10 mm in size, and a strength of the magnetic field is greater than 0.1 Tesla.
23. The method of claim 1 further comprising the step of dewatering the sludge.
- 5 24. The method of claim 1 further comprising the step of packaging and storing the sludge.
25. The method of claim 1 further comprising the step of recycling a portion of the magnetic sludge, to use the sludge as magnetic reagent.
26. The method of claim 25 wherein the fraction of the recycled sludge is in the  
10 range of about 10 mass % to 50 mass % of a total sludge mass.
27. The method of claim 1 further comprising the step of discharging the water separated from the sludge into a sewage network.
28. The method of claim 1 further comprising the step of returning the water separated from the sludge to a technological process.
- 15 29. The method of claim 1 further comprising the step of passing the water separating from the sludge through a layer of catalyst in the form of an ion-exchange fiber material.
30. The method of claim 29 wherein the water separated from the sludge is first passed through an ion-exchange catalyst, being in its neutral form, and thereafter is  
20 passed through the ion-exchange catalyst, being in its basic form, thereby to provide more complete removal of the intermediate products of the organic substance oxidation destruction.
31. A system for treating industrial wastewater, comprising:
- 25 a static mixer configured for continuous mixing the wastewater supplied thereto with desired reagents;
- a feeder of a magnetic powder configured for providing a ferromagnetic particulate material to said static mixer;
- a coagulator apparatus coupled to said static mixer, and configured for preparation of a basic coagulation agent and supplying thereof to said static  
30 mixer;



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a coagulator apparatus coupled to said static mixer, and configured for preparation of a acidic coagulation agent and supplying thereof to said static mixer;

at least one oxidizer apparatus coupled to said static mixer and configured for supplying an oxidizer thereto;

at least one flocculant apparatus coupled to said static mixer and configured for supplying at least one flocculant agent thereto selected from cationic flocculant and anionic flocculant, thereby to form flakes of the magnetic sludge in water; and

a magnetic separator configured for receiving the wastewater flowing downwardly from said static mixer and configured for applying a magnetic field across an effluent of the wastewater, thereby to separate the magnetic sludge from the water.

32. The system of claim 31 comprising a sludge suspension container downstream of said magnetic separator.

33. The system of claim 32 comprising a dryer downstream of said sludge suspension container and communicating with the static mixer for partial returning the magnetic sludge thereto.

34. The system of claim 31 comprising a first circulation pump for supplying the wastewater to said static mixer.

35. The system of claim 33 comprising a second circulation pump for supplying the magnetic sludge to said static mixer.

36. The system of claim 31 comprising a control unit configured for providing a control of the system.

37. The system of claim 31 comprising at least one sensor configured for generation a signal indicating at least a pressure or flow level.

38. The system of claim 31 comprising at least one water quality sensor adapted to indicate a water quality.

39. The system of claim 31 comprising at least one control valve adapted for regulating a wastewater flow.

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40. The system of claim 31 comprising at least one reagent supply valve.

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